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nited States Department of Agriculture,

BUREAU OF ENTOMOLOGY,

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THE TRUE CLOTHES MOTHS.

(*Tinea pellionella* et al.)

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The destructive work of the larvæ of the small moths commonly known as clothes moths, and also as carpet moths, fur moths, etc., in woolen fabrics, fur, and similar material during the warm months of summer in the North, and in the South at any season, is an altogether too common experience. The preference they so often show for woolen or fur garments gives these insects a much more general interest than is perhaps true of any other household pest.

The little yellowish or buff-colored moths sometimes seen flitting about rooms, attracted to lamps at night, or dislodged from infested garments or portieres, are themselves harmless enough, and in fact their mouth-parts are rudimentary, and no food whatever is taken in the winged state. The destruction occasioned by these pests is, therefore, limited entirely to the feeding or larval stage. The killing of the moths by the aggrieved housekeeper, while usually based on the wrong inference that they are actually engaged in eating her woolens, is, nevertheless, a most valuable proceeding, because it checks in so much the multiplication of the species, which is the sole duty of the adult insect.

The clothes moths all belong to the group of minute Lepidoptera known as Tineina, the old Latin name for cloth worms of all sorts, and are characterized by very narrow wings fringed with long hairs. The common species of clothes moths have been associated with man from the earliest times and are thoroughly cosmopolitan. They are all probably of Old World origin, none of them being indigenous to the United States. That they were well known to the ancients is shown by Job's reference to "a garment that is moth eaten," and Pliny has given such an accurate description of one of them as to lead to the easy identification of the species. That they were early introduced into the United States is shown by Pehr Kalm, a Swedish scientist, who took a keen interest in house pests. He reported these tineids to be abundant in 1748 in Philadelphia, then a straggling village, and says that clothes, worsted gloves, and other woolen stuffs hung up all summer were often eaten through and through by the worms, and furs were so ruined that the hair would come off in handfuls.

What first led to the association of these and other household pests with man is an interesting problem. In the case of the clothes moths, the larvæ of all of which can, in case of necessity, still subsist on almost any dry animal matter, their early association with man was probably in the rôle of scavengers, and in prehistoric times they probably fed on waste animal material about human habitations and on fur garments. The fondness they exhibit nowadays for tailor-made suits and other expensive products of the loom is simply an illustration of their ability to keep pace with man in his development in the matter of clothing from the skin garments of savagery to the artistic products of the modern tailor and dressmaker.

Three common destructive species of clothes moths occur in this country. Much confusion, however, exists in all the early writings on these insects, all three species being inextricably mixed in the descriptions and accounts of habits. Collections of these moths were submitted some years ago by Professors Fernald and Riley to Lord Walsingham, of Merton Hall, England, the world's authority on tineids, and from the latter's careful diagnosis it is now possible to separate and recognize the different species easily.

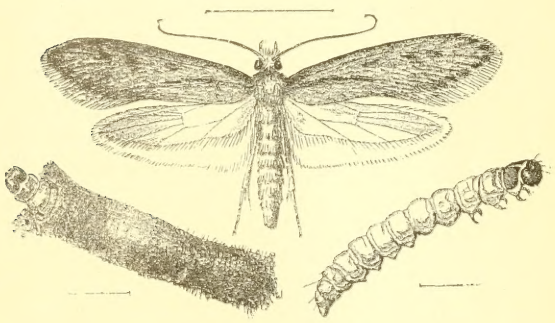

FIG. 1.—*Tinea pellionella*: Above, adult; at right, larva; at left, larva in case. Enlarged (from Riley).

The common injurious clothes moths are the case-making species (*Tinea pellionella* L.), the webbing species or Southern clothes moth (*Tineola biselliella* Hummel), and the gallery species or tapestry moth (*Trichophaga tapetzella* L.).

A few other species, which normally infest animal products, may occasionally also injure woolens, but are not of sufficient importance to be here noted.

THE CASE-MAKING CLOTHES MOTH.

The case-making clothes moth (*Tinea pellionella* L.) (fig. 1) is the only species which constructs for its protection a true transportable case. It was characterized by Linnæus, and carefully studied by Réaumur, early in the last century. Its more interesting habits have caused it to be often a subject of investigation, and its life history will serve to illustrate the habits of all the clothes moths.

The moth expands about half an inch, or from 10 to 14 mm. Its head and forewings are grayish yellow, with indistinct fuscous spots on

the middle of the wings. The hind wings are white or grayish and silky. It is the common species in the North, being widely distributed and very destructive. Its larva feeds on woolens, carpets, etc., and is especially destructive to furs and feathers. In the North it has but one annual generation, the moths appearing from June to August, and, on the authority of Professor Fernald, even in rooms kept uniformly heated night and day it never occurs in the larval state in winter. In the South, however, it appears from January to October, and has two or even more broods annually.

The larva is a dull white caterpillar, with the head and the upper part of the next segment light brown, and is never seen free from its movable case or jacket, the construction of which is its first task. If it be necessary for it to change its position, the head and first segment are thrust out of the case, leaving the thoracic legs free, with which it crawls, dragging its case after it, to any suitable situation. With the growth of the larva it becomes necessary from time to time to enlarge the case both in length and circumference, and this is accomplished in a very interesting way. Without leaving its case the larva makes a slit halfway down one side and inserts a triangular gore of new material. A similar insertion is made on the opposite side, and the larva reverses itself without leaving the case and makes corresponding slits and additions in the other half. The case is lengthened by successive additions to either end. Exteriorly the case appears to be a matted mass of small particles of wool; interiorly it is lined with soft whitish silk. By transferring the larva from time to time to fabrics of different colors the case may be made to assume as varied a pattern as the experimenter desires, and will illustrate, in its coloring, the peculiar method of making the enlargements and additions described.

On reaching full growth the larva attaches its case by silken threads to the garment or other material upon which it has been feeding, or sometimes carries it long distances. In one instance numbers of them were noticed to have scaled a 15-foot wall to attach their cases in an angle of the cornice of the ceiling. It undergoes its transformations to the chrysalis within the larval case, and under normal conditions the moth emerges three weeks later, the chrysalis having previously worked partly out of the larval case to facilitate the escape of the moth. The latter has an irregular flight and can also run rapidly. It has a distinct aversion to light, and usually conceals itself promptly in garments or crevices whenever it is frightened from its resting place. The moths are comparatively short-lived, not long surviving the deposition of their eggs for a new generation of destructive larvæ. The eggs are minute, not easily visible to the naked eye, and are commonly placed directly on the material which is to furnish the larvæ with food. In some cases they may be deposited in the crevices of trunks or boxes, the newly hatched larvæ entering through these crevices.

In working in feathers this insect occasionally causes a felting very similar to that produced by the black carpet beetle, *Attagenus piceus* Ol.

The protection afforded by the seclusion of this insect in houses does not prevent its having insect enemies, and at least two hymenopterous parasites have been reared in this country from its larval cases. These are *Hyperacmus tineæ* Riley MS., and *Apanteles carpatus* Say, both reared from specimens collected in Michigan.

THE WEBBING, OR SOUTHERN CLOTHES MOTH.

The webbing, or Southern clothes moth (*Tineola biselliella* Hummel) (fig. 2) is the more abundant and injurious species in the latitude of Washington and southward. It occurs also farther north, though in somewhat less numbers than the preceding species. It presents two annual broods even in the Northern States, the first appearing in June from eggs deposited in May, and the second in August and September. It is about the size of *pellionella*. The forewings are, however, uniformly pale ocherous, without markings or spots. Its larva feeds on a large variety of animal substances—woolens, hair, feathers, furs, and in England it has even been observed to feed on cobwebs in the corners of rooms, and in confinement has been successfully reared on this rather dainty food substance. The report that it feeds on dried plants in herbaria is rather open to question, as its other recorded food materials are all of animal origin.

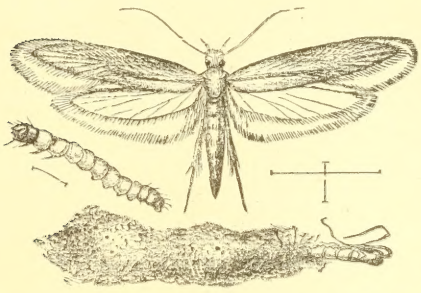

FIG. 2.—*Tineola biselliella:* Moth, larva, cocoon, and empty pupa skin. Enlarged (from Riley).

Frequently this species is a very troublesome pest in museums, particularly in collections of the larger moths. Prof. F. M. Webster, of this Bureau, once had some of his large moths badly riddled by its larvæ, and Hagen also records it as feeding on insect collections. Doctor Riley reared it in conjunction with the Angoumois grain moth (*Sitotroga cerealella*) from grain, it being apparent that its larvæ had subsisted on dead specimens of the grain moth. It is very likely to attack large Lepidoptera on the spreading board, and has, in fact, been carried through several generations on dried specimens of moths.

Its general animal-feeding habit is further indicated by the interesting case reported by Dr. J. C. Merrill, U. S. A., who submitted a sample can of beef meal which had been rejected as "weevilly." The damage proved to be due to the larvæ of *Tineola biselliella*, and goes to substantiate the theory already advanced that clothes moths were scavengers in their earliest association with man.

The larva of this moth constructs no case, but spins a silky, or more properly cobwebby, path wherever it goes. When full grown it builds a cocoon of silk, intermixed with bits of wool, resembling somewhat the case of *pellionella*, but more irregular in outline. Within this it undergoes its transformation to the chrysalis, and the moth in emerging leaves its pupal shell projecting out of the cocoon as with the preceding species.

THE TAPESTRY MOTH.

The tapestry moth (*Trichophaga tapetzella* L.) (fig. 3) is rare in the United States. It is much larger than either of the other two species, measuring three-fourths inch in expansion of wings, and is more striking in coloration. The head is white, the basal third of the forewings black, with the exterior two-thirds of a creamy white, more or less obscured on the middle with gray; the hind wings are pale gray.

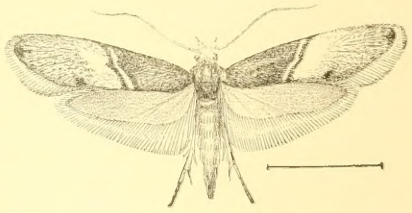

FIG. 3.—*Trichophaga tapetzella:* Adult moth. Enlarged (from Riley).

This moth normally affects rather coarser and heavier cloths than the smaller species and is more apt to occur in carpets, horse blankets, and tapestries than in the finer and thinner woolen fabrics. It also affects felting, furs, and skins, and is a common source of damage to the woolen upholstering of carriages, being rather more likely to occur in carriage houses and barns than in dwelling houses. Its larva enters directly into the material which it infests, constructing burrows or galleries, which it lines more or less completely with silk. Within these galleries it is protected and concealed during its larval life, and later undergoes its transformations without other protection than that afforded by the gallery. The damage is due as much or more to its burrowing than to the actual amount of the material consumed for food.

One of the parasites reared from *pellionella* (*Apanteles carpatus* Say) has also been reared from this species at St. Louis, Mo.

REMEDIES.

There is no easy method of preventing the damage done by clothes moths, and to maintain the integrity of woolens or other materials which they are likely to attack demands constant vigilance, with frequent inspection and treatment. In general, they are likely to affect injuriously only articles which are put away and left undisturbed for some little time. Articles in daily or weekly use, and apartments frequently aired and swept, or used as living rooms, are not apt to be seriously affected. Carpets under these conditions are rarely attacked, except sometimes around the borders, where the insects are not so much

disturbed by walking and sweeping. Agitation, such as beating, shaking, or brushing, and exposure to air and sunlight, are old remedies and still among the best at command. Various repellents, such as tobacco, camphor, naphthaline cones or balls, and cedar chips or sprigs, have a certain value if the garments are not already stocked with eggs or larvæ. The odors of these repellents are so disagreeable to the parent moths that they are not likely to come to deposit their eggs as long as the odor is strong. As the odor weakens the protection decreases, and if the eggs or larvæ are already present, these odors have no effect on their development; while if the moths are inclosed with the stored material to be protected by these repellents, so that they can not escape, they will of necessity deposit their eggs, and the destructive work of the larvæ will be little, if at all, restricted. After woolens have been given a vigorous and thorough treatment and aired and exposed to sunlight, however, it is of some advantage in packing them away to inclose with them any of the repellents mentioned. Cedar chests and wardrobes are of value in proportion to the freedom of the material from infestation when stored away; but, as the odor of the wood is largely lost with age, in the course of a few years the protection greatly decreases. Furs and such garments may also be stored in boxes or trunks which have been lined with heavy tar paper used in buildings. New papering should be given to such receptacles every year or two. Similarly, the tarred paper moth bags obtainable at dry-goods houses are of some value; always, however, the materials should first be subjected to the treatment outlined above.

To protect carpets, clothes, and cloth-covered furniture, furs, etc., these should be thoroughly beaten, shaken, brushed, and exposed as long as practicable to the sunlight in early spring, either in April, May, or June, depending on the latitude. The brushing of garments is a very important consideration, to remove the eggs or young larvæ which might escape notice. Such material can then be hung away in clothes closets which have been thoroughly cleaned, and, if necessary, sprayed with benzine about the cracks of the floor and the baseboards. If no other protection be given, the garments should be examined at least once a month during summer, brushed, and, if necessary, exposed to the sunlight.

It would be more convenient, however, so to inclose or wrap up such material as to prevent the access of the moths to it, after it has once been thoroughly treated and aired. This can be easily effected in the case of clothing and furs by wrapping tightly in stout paper or inclosing in well-made bags of cotton or linen cloth or strong paper. Doctor Howard has adopted a plan which is inexpensive, and which he has found eminently satisfactory. For a small sum he secures a number of the large pasteboard boxes, such as tailors use, and in these packs away all winter clothing, gumming a strip of wrapping paper

around the edge, so as to seal up the box completely and leave no cracks. These boxes with care will last many years. With thorough preliminary treatment it will not be necessary to use the tar-impregnated paper sacks sold as moth protectors, which may be objectionable on account of the odor.

In the case of cloth-covered furniture and cloth-lined carriages, which are stored or left unused for considerable periods in summer, it will probably be necessary to spray them twice or three times, viz, in April, June, and August, with benzine or naphtha, to protect them from moths. These substances can be applied very readily with any small spraying device, and will not harm the material, but caution must be exercised on account of their inflammability. Another means of protecting such articles is to sponge them very carefully with a dilute solution of corrosive sublimate in alcohol, made just strong enough not to leave a white stain.

The method of protection adopted by one of the leading furriers of Washington, who also has a large business and experience in storing costly furs, etc., is practically the course already outlined. Furs when received are first most thoroughly and vigorously beaten with small sticks, to dislodge all loosened hair and the larvæ or moths. They are then gone over carefully with a steel comb and packed away in large boxes lined with heavy tar roofing paper, or in closets similarly lined with this paper. An examination is made every two to four weeks, and, if necessary at any time, any garment requiring it is rebeaten and combed. During many years of experience in this climate, which is especially favorable to moth damage, this merchant has prevented any serious injury from moths.

COLD STORAGE.

The best method of protection, and the one now commonly adopted by dealers in carpets, furs, etc., is cold storage. In all large towns anyone can avail himself of this means by patronizing storage companies, and safety will be guaranteed.

The most economical degree of cold to be used as a protection from clothes moths and allied insects destructive to woolens and furs has been definitely determined by the careful experiments carried out at the instance of Doctor Howard by Dr. Albert M. Read, manager of a large storage warehouse company in Washington, D. C. These experiments demonstrated that a temperature maintained at 40° F. renders the larval or other stages of these insects dormant and is thoroughly effective. The larvæ, however, are able to stand a steady temperature as low as 18° F. without apparently experiencing any ill results. Doctor Read's experiments have extended over two years, and his later results as reported by Doctor Howard are very interesting. They have demonstrated that while a temperature kept uniformly at 18° F. will not destroy

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the larvæ of *Tineola biselliella* or of the black carpet beetle (*Attagenus piceus*), "an alternation of a low temperature with a comparatively high one invariably results in the death of the larvæ of these two insects. For example, if larvæ of either which have been kept at a temperature of 18° F. are removed to a temperature of 40° to 50° F., they will become slightly active and, when returned to the lower temperature and kept there for a little time, will not revive upon a retransfer to the warmer temperature."

It is recommended, therefore, that storage companies submit goods to two to three changes of temperature as noted before placing them permanently in an apartment kept at a temperature of from 40° to 42° F. The maintenance of a temperature lower than the last indicated is needless and a wasteful expense. Where the cost of cold storage is not an item to be seriously considered, the adoption of this method for protection of goods during the hot months is strongly recommended.

Approved:

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *December 20, 1907.*

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